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Flipped classroom as a methodology for acquiring skills in sustainability in the subject production management: an assessment of the students

Flipped classroom como metodología de adquisición de competencias en sostenibilidad en la asignatura production management: una valoración de los estudiantes

María Luz Martín-Peña*
https://orcid.org/0000-0002-6700-6293 (ORCID iD)
Universidad Rey Juan Carlos (Spain)

Eloísa Díaz-Garrido
https://orcid.org/0000-0003-0351-8115 (ORCID iD)
Universidad Rey Juan Carlos (Spain)

José María Sánchez-López
https://orcid.org/0000-0002-2866-850X (ORCID iD)
Universidad Rey Juan Carlos (Spain)

Cristina García-Magro
https://orcid.org/0000-0002-4034-6546 (ORCID iD)
Universidad Rey Juan Carlos (Spain)

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*Corresponding author: luz.martin@urjc.es
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ABSTRACT

The need to integrate competences aligned with the Sustainable Development Goals (SDGs) into higher education curricula has gained considerable attention in recent years. While the literature shows an increase in research on this topic, there remains a scarcity of papers addressing effective strategies to foster students' environmental sustainability competencies and skills, through active pedagogical methods. A promising avenue to achieve this goal is the adoption of the Flipped Classroom methodology. This approach has proven its ability to guide students towards reflection and critical thinking, making it a good tool for promoting sustainability awareness. An experience of educational innovation is presented that develops SDG 12 "Guarantee sustainable consumption and production patterns", and SDG 9 "Industry, innovation and infrastructures", in the subject Production Management, with the aim of achieving the competence "environmental awareness". From the perspective of the students, an evaluation of the educational experience is presented. The results show the success of the Flipped Classroom methodology in providing students with a holistic understanding of the principles of sustainable development and their application through the SDGs within their academic trajectory. In particular, this approach provides them with the skills and aptitudes to promote sustainability.

Keywords: *SDGs, Education for Sustainable Development, Flipped Classroom, Production Management, Competences, Higher Education.*

RESUMEN

La necesidad de integrar las competencias alineadas con los Objetivos de Desarrollo Sostenible (ODS) en los planes de estudios de la enseñanza superior, ha cobrado notable impulso en los últimos años. Si bien la literatura muestra un aumento de la investigación en este tema, sigue habiendo una escasez de trabajos que aborden estrategias eficaces para fomentar las competencias y habilidades de sostenibilidad ambiental de los estudiantes, a través de métodos pedagógicos activos. Una vía prometedora para lograr este objetivo es la adopción de la metodología Flipped Classroom. Este enfoque ha demostrado su capacidad para guiar a los estudiantes hacia la reflexión y el pensamiento crítico, lo que lo convierte en una buena herramienta para promover la concienciación sobre la sostenibilidad. Se presenta una experiencia de innovación educativa que desarrolla el ODS 12 "garantizar modalidades de consumo y producción sostenibles", y el ODS 9 "industria, innovación e infraestructuras", en la asignatura Dirección de Producción, con el objetivo de alcanzar la competencia "conciencia medioambiental". Desde la perspectiva de los estudiantes, se presenta una evaluación de la experiencia educativa. Los resultados muestran el éxito de la metodología Flipped Classroom a la hora de proporcionar a los estudiantes una comprensión holística de los principios del desarrollo sostenible y su aplicación a través de los ODS dentro de su trayectoria académica. En particular, este enfoque les dota de las habilidades y aptitudes para promover la sostenibilidad.

Palabras clave. *ODS, Educación para el Desarrollo Sostenible, Aula Invertida, Dirección de Producción, Competencias, Educación Superior*

INTRODUCTION

In a world increasingly concerned about environmental challenges and sustainable development, mainstreaming the SDGs into higher education has become a priority. One of the key aspects of this integration is the "Environmental Awareness" competence, which seeks to foster students' engagement with environmental issues and their ability to address them in an effective way.

The general competence "Environmental Awareness" emerges as a key competence in today's environment, as environmental protection becomes a priority for economic and social actors. Thus, today's society is concerned about the degradation of the environment as a consequence of industrial activity, as it involves the consumption of a large amount of resources and energy, and gives rise to global environmental risks that require immediate solutions (Rezaee & Elam, 2000; Banerjee, 2001). This growing social concern causes changes in the environment surrounding the company, requiring significant actions in its production and management practices (Bansal & Roth, 2000). Environmental sustainability becomes a goal for many of them (Huppes & Isikawa, 2007; Prajogo, Tang, & Lai, 2012).

Different organisations have proposed awareness-raising actions for the implementation of the 2030 Agenda, including curricular sustainability, through the development of participatory teaching methods and the development of specific content in the subjects. Universities have a responsibility to address the SDGs, as they are responsible for training the next generation of leaders and key decision-makers (Chankseliani & McCowan, 2021).

Some studies have sought to identify barriers to the effective establishment of sustainable development in universities, finding that higher education institutions still need to do more to integrate sustainability into their curricula and research groups (Leal Filho et al., 2017; Chaleta et al., 2021) and even into their strategic plans (Bieler & McKenzie, 2017). Therefore, more efforts are thus needed to fully integrate sustainability competences into academic practices and programmes and to place more emphasis on innovative teaching methods that enable students to acquire sustainability competences (Corvers et al., 2016).

Martínez Casanovas et al., (2021) demonstrate the usefulness of applying active learning methodologies to foster the acquisition of competences that promote the 2030 Agenda and the SDGs. Following Centeno et al., (2020), Flipped Classroom turns out to be a more appropriate methodology for the student to delve into the problems facing the planet, be aware of them and, consequently, acquire the necessary skills that allow him to provide solutions.

So, Flipped Classroom has become a widely studied and applied methodology in the context of higher education (Akçayır & Akçayır, 2018). Authors such as Sohrabi & Iraj (2016, pp.514) define Flipped Classroom as "a model of instruction where what has traditionally been done in class is transferred to activities at home and what has traditionally been done at home is transferred as classroom activities". It is an approach that combines autonomous learning based on videos, readings etc. outside the classroom, to use class time for active, social, discussion and problem-solving learning activities (Abeysekera & Dawson, 2015; Rotellar & Cain, 2016; Lo & Hew, 2017; Akçayır & Akçayır, 2018).

The hallmark of the Flipped Classroom is engagement with content through practice, projects, problem solving and collaboration with peers (Blair, Maharaj, & Primus, 2016). This teaching methodology has been shown to positively impact on students' confidence, motivation and engagement (Awidi & Paynter, 2019) as class time becomes a learning experience similar to actual practice. It has also demonstrated its potential as a didactic strategy for the acquisition of certain competences (Abad-Segura & González-Zamar, 2019). However, there are few works that analyze its suitability to guide students towards the acquisition of sustainability skills in a specific way.

Precisely, previous studies have shown that the application of traditional methodologies based on lectures does not achieve the acquisition of certain competences by students (Martín-Peña et al., 2011), so it is necessary to develop more innovative methodologies (Mingorance & Calvo, 2013) to familiarise students with environmental issues and the SDGs (Lozano et al., 2019).

In response to this problem, the aim of this paper is to present how the flipped classroom methodology can be used for students to acquire the competence "environmental awareness" through the implementation of the SDGs in the subject of Production Management. In this subject, there is a lack of an integrated approach to sustainable production and operations. In order to resolve this limitation, the educational innovation experience framed in this work was proposed, adding "Environmental Awareness" to the set of competences of the subject.

The Production Management subject of the Degree in Business Administration and Management turns out to be appropriate for this analysis because its contents are directly related to environmental issues, and therefore to the principles and objectives of sustainable development. Specifically, many of the targets included in SDG 12 and 9 are reflected in this subject, such as: "sustainable management and efficient use of natural resources", "reduce waste generation through prevention, reduction, recycling and reuse activities", "encourage businesses, especially large and transnational corporations, to adopt sustainable practices and incorporate sustainability information into their reporting cycle", "promote inclusive and sustainable industrialisation" and "upgrade infrastructure and retrofit industries to make them sustainable, using resources more efficiently and promoting the adoption of clean and environmentally sound technologies and industrial processes". In this way, a novel approach to the subject of sustainable production management and operations is realised.

The experience developed plays a crucial role in achieving sustainable development and can be beneficial in several ways. Firstly, it can help students understand the relationship between production management and sustainable development. This understanding can help students contribute to the achievement of the SDGs by developing sustainable practices in their future careers. In addition, integrating the SDGs into production management can improve the employability of graduates. As more organisations prioritise sustainability, graduates who are well trained in sustainable production and operations management practices will have a competitive advantage in the labour market.

The paper is structured as follows. Next, a review of the literature is presented, followed by a description of the educational innovation experience developed in the Production Management subject. From data obtained from the students by means of a questionnaire, results are obtained, which are analysed and put in relation to the literature. It ends with conclusions, limitations and future work.

LITERATURE REVIEW

The literature review is raised around the two relevant topics in this paper, flipped classroom methodology and SDG in higher education, which aim to converge towards the proposed objective of using the flipped classroom methodology to achieve “environmental awareness” competence.

Authors such as Hopkinson & James, (2010) have already pointed out the need for sustainable development to be addressed in the classroom from a pedagogical approach. However, research focusing on the relationship between the way courses are taught (pedagogical approaches) and how they can affect sustainability competences is still limited (Lozano et al., 2019). Since each learning objective, situation and environment requires a particular pedagogical approach, a wide variety of proposals can be found. There seems to be general agreement that active, participatory and real-world learning approaches are essential for the inclusion of the SDGs and Education for Sustainability (Tilbury, 2011).

So, the implementation of the European Higher Education Area has already involved all faculty members in a methodological change that is focused on the learning process of the student (Montero-Curiel, 2010) where competency-based education has gained importance thanks to the employability requirements required by companies (Díez-Martín, 2018).

Angulo (2012) states that students have more positive opinions about those meaningful didactics in which they engage, and when they develop the thematic contents by themselves. Cervantes & Valdez (2020), establish that the teacher must motivate students through academic activities out of the classroom. The flipped classroom model has been revolutionising the scope of higher education in the last few decades because of the application of mixed-teaching models, which help to optimise the teaching–learning experience (Sosa-Díaz, Guerra-Antequera, & Cerezo-Pizarro, 2021).

Bergmann and Sams, chemistry teachers and promoters of the Flipped Classroom methodology, began to shape this methodology when they began recording podcasts, screencasts and online videos for students who could not attend class, thus offering them the opportunity to receive direct instruction outside the classroom (Prieto et al., 2021). They soon realized that the rest of the students made use of the material provided and took advantage of this situation to reverse the traditional dynamics of the class, ensuring that the merely curricular contents were worked outside the classroom, reinforcing them within it through the development of activities previously designed by the teacher (Bergmann & Sams, 2012).

Although at first glance it may appear to be a simple model, it is important to design and implement the method correctly for it to be effective (Khanova et al., 2015). Numerous flipped classroom design possibilities exist (Rotellar & Cain, 2016). Following Estes et al., (2014) flipped classroom design framework consists of preclass, inclass, and postclass learning activities. Preclass activities are typically readings, short recorded video or audio lectures, or some other form of computer-based instruction. When properly designed, preclass work should not contain excessive detail, but should cover primary learning points. In-class activities, the second stage of the framework, may consist of a variety of methods for clarifying preclass activity concepts including: quizzes given at the beginning of class, group learning activities, problem solving, case discussions, or other active-learning methods that apply to different learning types. Postclass learning activities in flipped classroom formats usually involve learning assessments and further application of skills or knowledge (Rotellar & Cain, 2016).

It is, therefore, a comprehensive approach (Touron & Santiago, 2015) that allows teachers to have more time in the classroom to deepen the contents they consider appropriate and students to acquire a leading and active role (El Miedany, 2019).

The benefits of the flipped classroom have been widely endorsed by the literature. Motivation, participation, autonomy (Hinojo-Lucena et al., 2020; MacLeod et al., 2018) and academic performance (see Sola-Martínez et al., 2019) have been the most studied study variables. In relation with motivation, the tendency has generally been to motivate students through extrinsic motivation, neglecting the fact that, if intrinsic motivation is encouraged, the rewards gained can be greater. This is how the flipped classroom works. Gross et al., (2015) show that the flipped classroom environment encourages engagement with the material offered, involves the student in their learning process through effort, offers more accurate preparation and, ultimately, improves academic results.

In addition, the numerous studies that have studied the most relevant aspects of the Flipped Classroom model have shown that its application is gaining importance as an effective alternative for the competence development proposed by the EHEA (Abad-Segura & González-Zamar, 2019).

The acquisition of generic competences has been the focus of most research. Thus, for example, Estriegana, Medina-Merodio, & Barchino (2018) investigates how flipped classroom plays a key role in the acquisition and development of systematic, personal and cooperative competences. More recently, Chura-Quispe et al., (2022) focuses on the effectiveness of Flipped

Classroom in developing academic writing competencies from the student's perspective and their results show that it is effective in improving academic writing in the university context. Similarly, Herrera, Vásquez, & Llaro (2022) conducted a review of the literature and concluded that the use of this strategy in higher education teaching improves critical thinking, collaborative work and autonomous learning.

The acquisition of environmental awareness skills has been considered to a lesser extent. Prominent themes in this field of study have included the implementation of the SDGs, the challenges and benefits associated with their implementation, trends in education for sustainable development and advocacy strategies. Some studies have sought to identify barriers to the effective establishment of sustainable development in universities, finding that higher education institutions still need to do more to integrate sustainability into their curricula and research groups (Leal Filho et al., 2017; Chaleta et al., 2021) and even into their strategic plans (Bieler & McKenzie, 2017). Studies such as the one carried out by Brandli et al., (2014) show that active teaching-learning methodologies offer students the opportunity to face real situations, which leads to both reflection and the development of their professional future in a sustainable way. Thus, traditional methodological approaches (such as lectures) need to be rethought and redesigned in order to better develop the sustainability competences defined in the different subjects (Lozano et al., 2019).

In the field of knowledge of business administration, Centeno et al., (2020) present an action research project in three areas of knowledge attached to the Faculty of Social Sciences and Communication of the European University of Madrid: economics and business, communication and legal and political sciences. The objective is focused on analyzing how, through the Flipped Classroom methodology, students manage to develop active learning skills, teamwork, ethical values and communication. This process brings them closer to sustainability and the SDGs. Their results show that this methodology turns out to be an effective method to achieve this. Although they emphasize how to include the SDGs in the curricula of the subjects, their study does not really focus on analyzing the degree to which students acquire environmental competencies but, as through other competencies, students get the necessary training to internalize the message contained in the 2030 Agenda. In this sense, the present work advances in this line and expands the work developed by Centeno et al., (2020) analyzing how flipped classroom helps students in the acquisition of environmental skills.

Annan-Diab & Molinari (2017), in the context of an Master in Business Administration, mention the importance of incorporating sustainable development throughout the curriculum from an integrated and multidisciplinary perspective, recognising the added value of different perspectives on sustainability. We consider it equally important to introduce the concept of sustainable development also in undergraduate studies.

In the specific subject of Production Management, previous work has focused on the integration of the theme of sustainable development in the subjects of Operations Management, within engineering studies (Fredriksson & Persson, 2011). Queiruga et al., (2015) present the results of applying different methodologies and developing activities with which to work on competences related to Education for Sustainable Development in Production Organisation subjects taught not only in Engineering Degrees, but also in Degrees in Labour Relations and Human Resources.

Therefore, with regard to the subject related to the discipline of Production Management, it deals with the management of the processes involved in obtaining and delivering goods and services and incorporate general and specific competences directly related to the functional area of production. In general, the teaching guides for these subjects, taught at different universities, include a competence related to "environmental awareness ". This competence is directly related to the SDGs included in the 2030 Agenda, SDG 12 "Ensure sustainable consumption and production patterns" and SDG 9 "Industry, innovation and infrastructure". In this way, it is possible to integrate aspects directly related to Sustainable Development in the subjects of Production and Operations

Management. As a result, students learn about sustainable development at the same time as they learn about Production and Operations Management (Fredriksson & Persson, 2011).

DESIGNING THE EDUCATIONAL INNOVATION EXPERIENCE: FLIPPED CLASSROOM IN ACTION

As Bristol (2014) states, before implementing flipped classroom, it is necessary to define the competences to be achieved from the student-centred teaching-learning process, which combines theoretical content with practice based on real-life problems. Therefore, it is necessary to define the learning objectives to be achieved, in order to subsequently organise the activities and tasks before, during and after the class (Gilboy, Heinerichs, & Pazzaglia, 2015). It is thus essential to contextualize the subject.

The Production Management subject of the Degree in Business Administration and Management deals with knowledge of the operations area in manufacturing companies, the production function with a strategic focus and decision-making linked to product, process, capacity, location and quality, with a marked theoretical-practical character. However, there is a lack of an integrated approach to sustainable production and operations. In order to resolve this limitation, the educational innovation experience framed in this work was proposed, adding "Environmental Awareness" to the set of competences of the subject.

The general competence "Environmental Awareness" emerges as a key competence in today's environment, as environmental protection becomes a priority for economic and social actors. Thus, today's society is concerned about the degradation of the environment because of industrial activity, as it involves the consumption of a large amount of resources and energy, and gives rise to global environmental risks that require immediate solutions (Rezaee & Elam, 2000; Banerjee, 2001). This growing social concern causes changes in the environment surrounding the company, requiring significant actions in its production and management practices (Bansal & Roth, 2000). Environmental sustainability becomes a goal for many of them (Huppes & Isikawa, 2007; Prajogo, Tang, & Lai, 2012).

The educational innovation experience developed is part of the compulsory internships of the Production Management subject. These practical activities are carried out in work groups among students. Following the proposal established by Estes et al., (2014), the planning involved the following phases:

PRE-CLASS

1. Selection of themes: Teachers identify subject content related to SDGs 9 and 12 and look for themes with which to develop this content. The topics selected are sustainable production, reverse logistics, electric vehicles and the implementation of telecommunications infrastructures in disadvantaged areas. These themes allow the development of the theoretical contents of the subject based on the strategic decisions of operations, such as product selection and design, production process, capacity, location, plant distribution, production planning, etc. The preparation of the topics involves the selection of relevant educational resources, such as videos, readings and case studies, in relation to the topics.

2. Pre-learning activities: Students receive the selected resources for each topic before the class. They should review them and acquire basic knowledge in relation to the content and the SDGs.

IN-CLASS

3. Inverted class: During the class, time is devoted to discussion and application of the concepts learned. Students are grouped into teams. Each team research how the SDGs relate to the topic and sustainable production and prepares a presentation.

4. Presentations and discussion: Teams present their proposals to the class. Discussion and reflection on the challenges and opportunities of implementing sustainable practices in the management of production is encouraged.

5. Group project: Students work on a practical project in which they must apply the concepts learned about sustainable production and the SDGs. They can develop an improvement plan for a company, analyse a real case or design an environmental management strategy.

POST-CLASS

6. Evaluation: Students' performance is evaluated on the basis of their participation in discussions, the quality of their proposals and the effectiveness of their practical project. Both knowledge and skills are assessed.

In each of the topics, they are provided with basic background information and are activated by questions, the answers to which require different actions. Inditex, Meliá, Vega Sicilia and Tesla are chosen as practical cases. The choice of these companies is motivated by the fact that they represent key industrial sectors that have a significant impact on sustainability and sustainable development. In addition, they provide public information on their websites which is easily accessible to students and very useful for the requested tasks. Students have to search for documentation, make proposals, discuss them, present them and reach conclusions. All of this is done with feedback between the working groups and the teacher, who acts as moderator.

For the topic of sustainable production, the aim is for students to learn about the concept and its importance in the achievement of some sustainable development objectives. The groups receive information with basic ideas of what sustainable production is, with examples of companies that are committed to it. In this case, Vega Sicilia, Inditex and Meliá are analyzed. They are all companies that have opted for sustainable production in various sectors. The service sector is also introduced into this topic through Meliá (although the subject is manufacturing, references are made to services many times throughout it). Students work on this information outside the classroom and have to look for more information to answer a series of questions. Thus, they are asked to identify common aspects and differences of Sustainable Production in each company and to answer what strategic and operational implications does Sustainable Production have for the company? As a group, in the classroom, the answers are discussed, and conclusions are drawn. As independent work, each student submits a critical essay on the reading "Sustainable Consumption and Production".

The reverse logistics topic aims to present reverse logistics as a path towards sustainable production. The aim is to find out what reverse logistics is and its current importance for the achievement of sustainable development and as a new business model. Based on a real case of the recycling of electrical appliances, the students have to look for information for the specific case of mobile phones, based on the following ideas: What is done for the recycling of mobile devices? Describe different initiatives. Proposals for sustainable production and recycling in the case of mobile devices. As a group in the classroom, the answers are discussed, and conclusions are drawn. As independent work, each student submits a critical essay on the reading "Waste management in electrical and electronic equipment".

The subject of electric vehicles is approached from the perspective of production and consumption. The aim is to find out how the response to environmental regulations is leading the automotive sector to the new product that the electric car represents, with many implications for the business model. Also, the motivations and implications for the purchase and use of an electric vehicle. From a video illustrating the production of the electric car, using Tesla as study case, students must seek information on its impact on the environment, as well as on the new business and consumption models around the electric car, including digital car sharing platforms. As a group in the classroom, they discuss their answers and draw conclusions.

The thematic focus on the development of telecommunications infrastructure in disadvantaged areas is associated with identifying and analysing those companies whose core business is most

directly linked to SDG 9, such as companies belonging to the telecommunications sector. The aim is to seek information and identify the case of a particular company or specific business action aimed at facilitating access to telecommunications infrastructure in disadvantaged areas. No company is provided as a case study, students are instructed to carry out the search work. These disadvantaged areas may be developing countries or rural areas with depopulation problems. Students should not only critically analyse how such companies are contributing to SDG 9, but also make different proposals.

ASSESSMENT OF THE EXPERIENCE BY THE STUDENTS

Objectives

The question arises: how to work on these contents, competences and the approach to the principles of sustainable development and SDGs in the Production Management subject?. In order to answer this question, the educational innovation experience presented here raises the following objectives:

- provide students with a global and integrative vision of the sustainable production and operations function, as well as the objectives of sustainable development.
- Specifically relate the content of the subject to SDGs 12 and 9 and their targets.
- Put into action the general competence "Environmental Awareness".

Instruments

The educational innovation experience has been developed during three academic years, specifically in the academic years 2020-21, 2021-22 and 2022-23. A total of 360 students and 4 professors have participated. At the end of the course in each academic year, information was collected from the students by means of an anonymous questionnaire. The questionnaire consisted of 5 blocks of questions that allow us to assess different aspects such as: importance of the SDGs in the Production and Operations Management area, importance of the "Flipped Classroom Methodology", results on general competences, learning results on SDGs and Sustainability, and assessment of the educational experience. The data are from May 2021, 2022 and 2023. A total of 319 valid questionnaires were obtained, with a participation of 89% of the students enrolled in the subject during the three academic years.

The questionnaire was adapted based on questionnaires used in previous research, such as Build-Fabregá et el., (2019) and Díaz Garrido et al., (2017) with regard to the Flipped classroom methodology, and AISHE 2.0 in the education module (Assessment Instrument of Sustainability in Higher Education) (Brandli et al., 2014). The questionnaire consisted of a total of 33 questions, defined on a scale (0=strongly disagree and 10=strongly agree).

Results

The information obtained from the different questionnaires allowed us to carry out the relevant analyses to achieve the objective pursued in our research. Specifically, the most characteristic descriptive statistics (mean values and indicators of variability) were calculated for each of the 33 items assessed. The results are shown in Table 1. The scores obtained on the different items are generally high and highly clustered. In this table, the data associated with each question are given for the whole period (without differentiating years). In addition, the information collected is grouped into blocks and the statistics associated with each block are calculated.

Table 1. Sample Statistics (aggregate).

STUDENT OPINION	Mean	Median	Mode	Standard Deviation	C.V.Pearson
Importance of SDGs in the POM area	**BLOCK 1** (4 questions)				
Environmental protection	**8.837**	9	9	1.102	0.125
SDG 09	**8.784**	9	9	1.139	0.130
SDG 12	**8.467**	9	9	1.382	0.163
Economic advantages are derived	**7.100**	8	7	1.620	0.228
Block 1 grouped	**8.297**	9	9	1.503	0.181
Importance of "Flipped Classroom Methodology".	**BLOCK 2** (7 questions)				
It is motivating	**8.304**	10	9	1.694	0.204
Stimulates learning and reflection	**9.276**	9	9	0.688	0.074
Improve communication with the teacher	**9.044**	9	9	0.873	0.097
Teacher knows strengths and weaknesses in learning	**8.307**	8	8	1.346	0.162
It allows to better relate the concepts dealt with	**8.210**	8	8	1.439	0.175
Enables/stimulates autonomy in learning	**8.918**	10	9	1.029	0.115
Helping to assimilate SDG issues	**8.097**	7	8	1.182	0.146
Block 2 grouped	**8.593**	9	9	1.684	0.151
Results on general competences	**BLOCK 3** (6 questions)				
Initial analysis of information	**7.906**	8	8	1.660	0.210
Developing teamwork	**8.345**	9	8	1.042	0.125
Organisation and Planning	**8.458**	9	8	1.061	0.125
Critical reasoning	**8.113**	8	8	1.174	0.145
Problem solving	**8.135**	9	8	1.093	0.134
Sensitivity to environment and SDGs	**8.928**	10	9	1.040	0.117
Block 3 grouped	**8.314**	8	9	1.242	0.149
Learning outcomes: SDGs and Sustainability	**BLOCK 4** (5 questions)				
Knowledge/implementation SDG 09	**9.069**	10	9	0.961	0.106
Knowledge/implementation SDG 12	**9.075**	10	9	0.960	0.106
Knowledge/application Environment and sustainability	**9.082**	10	9	0.957	0.105
Multidisciplinary SDGs and sustainability (other subjects)	**8.881**	9	9	1.019	0.115
SDGs-sustainability: I want to go deeper into the future	**8.345**	9	8	1.245	0.149
Block 4 grouped	**8.890**	9	9	1.072	0.121
Assessment of educational experience	**BLOCK 5 (**10 questions)				
General content	**8.285**	9	8	1.096	0.132
SDG 09 content	**8.436**	9	8	1.042	0.124
SDG 12 content	**8.455**	8	8	1.031	0.122
Environment and sustainability content	**7.978**	8	8	1.333	0.167
Content/activity "sustainable production"	**8.696**	9	9	1.050	0.121
Content/activity "reverse logistics"	**8.790**	9	9	1.081	0.123
Content/activity "electric vehicle"	**9.009**	10	9	1.099	0.122
Content/activity "telecommunications"	**8.784**	9	9	1.089	0.124
Classroom activities (presentations, discussions …)	**8.774**	9	9	1.001	0.114
Out-of-class activities (readings and videos)	**7.075**	7	7	1.344	0.190
Block 5 grouped	**8.428**	9	9	1.243	0.147
Overall assessment	**8.567**	9	9	0.957	0.112

In block one the student assesses the desirability, necessity, and importance of the SDGs in the area of Production and Operations Management (POM).

It stands out that the participating students consider the area of production and operations to be of great importance in the protection of the environment (8.837), in the achievement of SDG 09 (8.784) and SDG 12 (8.467). In contrast, the achievement of economic benefits is comparatively less valued (7.100) and has more variability (0.228). This situation leads to the score of this block being the lowest with a value of 8.29 out of 10. It also has the highest variability (0.181). It can be interpreted that there is a realistic/practical view on the implementation of these measures. This

shows an appreciation of the importance of balancing economic and sustainability objectives in the context of production management. On the other hand, it should be noted that the subject Production Management is the only one in which the competence "Awareness of environmental issues" has been worked on in the degree programme. This suggests a strategic approach to promoting environmental and sustainability awareness from the earliest stages of learning.

This is followed by block two, associated with the Flipped Classroom Methodology. The aim is to study the opinion and satisfaction of students with this method in the area of Production and Operations Management.

The data show that it is a well-appreciated methodology and that it improves the use of all the teaching resources used. Support for the statements "Stimulates learning and reflection" and "Improves communication with the teacher" stand out, both with mean scores above 9 and very low levels of variability (consensus among students). In contrast, the level of student motivation shows some variability (0.204). The variability in student motivation could be due to the diversity of learning profiles and styles, suggesting the importance of adapting the methodology to the individual needs of students.

The result or level of achievement of the general competences is analysed in the third block of questions of the survey. The not very high average in "Initial analysis of information" (7.906) may be due to a higher commitment to its further processing. The higher average in this group is associated with "Sensitivity towards environment and SDGs" (8.928) derives from the teachers' efforts on that particular topic. Aspects of "Organisation and Planning" (8.458) can also be highlighted, which are essential and therefore practised in the flipped classroom methodology. Group work (8.345) is also highly valued. This shows the effectiveness of the flipped classroom methodology in the acquisition of generic competences by students, which is consistent with other previous studies carried out in subjects in the discipline of Production and Operations Management (Martín Peña, et al., 2011) and related disciplines (Abad-Segura & González-Zamar, 2019).

Block four is dedicated to learning outcomes on SDGs and sustainability. Learners score themselves (self-assessment). This block stands out for its learning outcomes, the block score is the highest with a value of 8.89 out of 10 (almost all the modes are 10). This could lead to the assertion that a very effective methodology has been given in a correct way and that teachers should be well valued. In addition, students consider it necessary to include the study of SDGs in the rest of the subjects of their degree according to the results of the question "Multidisciplinary view of SDGs and sustainability (other subjects)".

Finally, in block five, we move on to the assessment of the educational experience, highlighting the teaching of SDGs. In this block, all the scores are high: the student values that the experience is designed to make him/her think and discover issues by him/herself before they are explained by the teacher. Although all the average ratings for the specific activities are high, the activity on "electric vehicles" stands out (average above 9). It is a very topical subject, and this may influence the interest shown by the students.

On the other hand, the "Activities outside the classroom (readings and videos)" can be analysed. It seems that when students have to work independently, they do not express such high evaluations (mean of 7.075), and present different opinions among themselves (higher variability) either because they doubt the effectiveness or usefulness of the activities outside the classroom or because they are an excessive effort.

The overall rating, coherent with the rest of the items (8.567), is high. 87% of the students score 8 or more out of 10. Eighty-seven percent of the students scored it 8 or more out of 10. A low variability in this overall rating can be highlighted, indicating a high degree of agreement among the students with regard to their educational experience (0.112).

In summary, the values that students assign to all items are high (averages above 8 in most cases) and scores between 0 and 4 are practically unused. Although this indicates good results, it should be remembered that 11% of the students do not participate (no response) and could be the

ones who would contribute the lowest scores (non-response bias). Nevertheless, the percentage of non-response can be considered low.

Since the data was taken in three different years, pandemic involved. It would be good to explore whether there are differences between the period before, during and after the pandemic. The results are thus shown in Table 2.

Table 2. Sample Statistics (by years).

STUDENT OPINION	Year 20/21 Mean (S.D.)	Year 21/22 Mean (S.D.)	Year 22/23 Mean (S.D.)
Importance of SDGs in the POM area			
Environmental protection	**8.495** (1.131)	**8.867** (1.096)	**9.115** (0.993)
SDG 09	**8.505** (1.340)	**8.848** (1.085)	**8.973** (0.926)
SDG 12	**8.089** (1.422)	**8.486** (1.381)	**8.788** (1.258)
Economic advantages are derived	**6.337** (1.643)	**7.076** (1.700)	**7.805** (1.136)
Importance of "Flipped Classroom Methodology".			
It is motivating	**7.584** (1.966)	**8.314** (1.675)	**8.938** (1.083)
Stimulates learning and reflection	**9.146** (0.750)	**9.302** (0.675)	**9.363** (0.625)
Improve communication with the teacher	**8.772** (1.033)	**9.038** (0.827)	**9.292** (0.661)
Teacher knows strengths and weaknesses in learning	**7.693** (1.391)	**8.524** (1.367)	**8.655** (1.071)
It allows to better relate the concepts dealt with	**7.485** (1.583)	**8.552** (1.250)	**8.540** (1.212)
Enables/stimulates autonomy in learning	**8.654** (1.048)	**8.876** (1.093)	**9.195** (0.871)
Helping to assimilate SDG issues	**7.673** (1.063)	**7.905** (1.109)	**8.655** (1.135)
Results on general competences			
Initial analysis of information	**7.337** (1.731)	**7.867** (1.768)	**8.451** (1.269)
Developing teamwork	**7.921** (0.875)	**8.400** (1.047)	**8.673** (1.043)
Organisation and Planning	**8.228** (1.089)	**8.429** (1.022)	**8.690** (1.023)
Critical reasoning	**7.663** (0.926)	**8.095** (1.276)	**8.531** (1.122)
Problem solving	**7.812** (0.982)	**8.152** (1.085)	**8.407** (1.118)
Sensitivity to environment and SDGs	**8.485** (1.113)	**9.067** (0.998)	**9.195** (0.871)
Learning outcomes: SDGs and Sustainability			
Knowledge/implementation SDG 09	**8.911** (1.073)	**9.143** (0.940)	**9.142** (0.850)
Knowledge/implementation SDG 12	**8.871** (1.050)	**9.162**(0.937)	**9.177** (0.865)
Knowledge/application Environment and sustainability	**9.000** (1.024)	**9.067** (0.998)	**9.168** (0.840)
Multidisciplinary SDGs and sustainability (other subjects)	**8.644** (1.077)	**8.867** (1.033)	**9.106** (0.896)
SDGs and sustainability: I want to go deeper into the future	**7.960** (1.475)	**8.238** (1.083)	**8.788** (1.000)
Assessment of educational experience			
General content	**8.069** (1.237)	**8.219** (1.113)	**8.540** (0.873)
SDG 09 content	**8.089** (1.091)	**8.400** (1.029)	**8.779** (0.890)
SDG 12 content	**8.248**(1.075)	**8.314** (0.979)	**8.770** (0.959)
Environment and sustainability content	**7.822** (1.563)	**8.076** (1.224)	**8.027** (1.186)
Content/activity "sustainable production"	**8.446** (1.156)	**8.505** (0.937)	**9.097** (0.921)
Content/activity "reverse logistics"	**8.386** (1.312)	**8.648** (0.905)	**9.283** (0.770)
Content/activity "electric vehicle"	**8.654** (1.230)	**9.200** (0.970)	**9.150** (1.006)
Content/activity "telecommunications"	**8.495** (1.332)	**8.581** (0.913)	**9.230** (0.820)
Classroom activities (presentations, discussions, solutions)	**8.406** (1.064)	**8.848** (1.003)	**9.035** (0.830)
Out-of-class activities (readings and videos)	**6.426** (0.998)	**6.962** (1.309)	**7.761** (1.326)
Overall assessment	**8.188** (0.930)	**8.648** (0.966)	**8.832** (0.861)

In all items, scores improve over time. The cause may be twofold. There is a possible improvement effect on teaching due to overcoming the pandemic and an experience effect on the teaching staff.

The most significant changes in scores are in the questions associated with "Importance of Flipped Classroom Methodology". Between the first and the third year, there is a notable increase in scores for the following questions: "It is motivating" and "It allows to better relate the concepts dealt with". Also interesting are the improvements in "Results on general competences", especially in "Initial analysis of information" and "Critical reasoning".

Finally, it is worth noting the students' opinion regarding "Out-of-class activities (readings and videos)". Although the scores are relatively low, they increase considerably (from 6.426 to 7.761). It seems that an initial tendency of the students is overcome, and they become more proactive outside the classroom due to this methodology.

These results show the importance of the development of active and reflective learning by students in the subjects, which in our case has been achieved thanks to the flipped classroom teaching methodology. Moreover, such learning is considered essential in developing certain competences and skills such as awareness of environmental issues, a competence directly related to education for sustainability.

It seems that the students surveyed consider that the SDGs have been adequately addressed in the subject and that the methodology used has helped their knowledge, as they have had to face real problems and situations.

With the experience developed, an approach towards sustainable production and operations management has been realised. Sustainable operations integrate the traditional efficiency orientation of production management with broader considerations of internal and external stakeholders and their environmental impact (Kleindorfer et al., 2005), and is directly related to the SDGs.

CONCLUSIONS

Sustainable development has become a crucial topic in higher education, and universities are striving to equip students with the knowledge and skills needed to create a more sustainable future. As part of this effort, many institutions are introducing the Sustainable Development Goals (SDGs) into their curricula.

This work proposes the implementation of SDG 12 and SDG 9 on "Ensure sustainable consumption and production patterns" and "Industry, innovation and infrastructure", in the Production Management subject of the Degree in Business Administration and Management, for the acquisition of the general competence "Environmental Awareness". The contents of the program are directly related to these SDGs.

The acquisition of this general competence has been carried out through the Flipped Classroom methodology, which has allowed the students to work on other curricular competences, such as teamwork, autonomous learning and critical reasoning skills, in addition to environmental awareness. The results obtained confirm the effectiveness of this methodology for the acquisition of the competence "Environmental Awareness". When students are involved in the dynamics of the flipped classroom, the teaching-learning process improves significantly and, consequently, the development of competences.

This experience contributes to the implementation of awareness-raising actions in university classrooms for the implementation of the 2030 Agenda in relation to the fulfilment of the SDGs. For this purpose, current topics included in the subject are analyzed, such as recycling, sustainable production and electric vehicles, among others. Mostly industrial companies have been included, although the case of a service company has been proposed to illustrate that environmental problems also affect this sector of activity. In short, the focus is on environmental sustainability, with students having to search for information, analyse it, synthesise it, and draw conclusions that are shared in working groups.

Thus, this work has important implications from both a theoretical and practical point of view. From a theoretical point of view, firstly, an important contribution is made to education for sustainability, in the sense that this experience supports the idea that integrating the SDGs into the higher education curriculum can be effective, provided that appropriate teaching-learning methodologies are used. Secondly, it highlights the importance of adopting a multidisciplinary approach to education for sustainability, as students demand the need for other courses to integrate the study of the SDGs. This may lead to a change in the way educational institutions design their curricula, encouraging collaboration between different disciplines.

From a practical perspective, incorporating the SDGs into higher education curricula has several advantages. Firstly, it provides students with a deeper understanding of the global challenges facing the world, and how these challenges can be addressed through sustainable practices. This, in turn, encourages students to take responsibility for their actions and become active agents of change.

Secondly, interdisciplinary learning is promoted, as the SDGs cover a wide range of areas, such as environmental sustainability, social justice and economic development. This allows students from diverse fields to collaborate and develop innovative solutions to global challenges.

Thirdly, incorporating the SDGs into curricula can also improve the employability of graduates. As companies and organisations increasingly prioritise sustainability, students with a strong understanding of sustainable development will have a competitive advantage in the labour market.

Finally, for the subject analysed in this paper, the introduction of the SDGs in the content and competences has provided students with a broader and more contextualised understanding of global challenges and has fostered their commitment to sustainability. It highlights the importance of cultivating in students the ability to identify, analyse and propose solutions to current and future environmental challenges. By developing the "Environmental Awareness" competence in Higher Education, an engaged and empowered global citizenry is fostered to contribute to the achievement of the SDGs and care for the environment.

Notwithstanding the theoretical and practical contributions highlighted above, we have identified some limitations in the development of this work. Thus, the choice of SDGs 12 and 9 has been made looking for a very direct relationship with the subject of study, although it is possible to consider other SDGs that can also be indirectly related. The choice of the Flipped Classroom methodology also imposes a particular subject development, which may be conditioning the results. In addition, the application of this methodology has presented some difficulties to the teaching staff, for example, in relation to the search for adequate and up-to-date educational resources related to the SDGs and the discipline of Production Management, requiring the investment of a lot of time to research and collect relevant teaching materials, to train in the application of the methodology and to adapt to new ways of teaching, increasing the teacher's workload. Similarly, students have different levels of knowledge and commitment, so it was sometimes necessary to adapt the methodology to meet the needs of a variety of student groups. Finally, one of the years of the study was the 2020-2021 academic year, marked by the COVID19 pandemic, which introduced many restrictions in the normal development of teaching activities; although the subject under analysis is taught in the second semester, in which the main obstacles had already been overcome in order to be able to develop classes with a certain degree of normality.

These limitations open future lines of work. One promising future line could be to study the integration of additional Sustainable Development Goals into the subject of Production Management. While this study focused on specific SDGs like SDG 9 and SDG 12, there are 17 SDGs in total, each with its unique set of challenges and opportunities. This would provide a more comprehensive understanding of the potential impact of such integration on students' awareness and competencies related to sustainability.

While this experience has demonstrated the effectiveness of the flipped classroom methodology, future research can focus on the exploration of alternative active teaching

methodologies. Comparative studies could be conducted to assess the strengths and weaknesses of different approaches, such as project-based learning, experiential learning, or problem-based learning, in terms of their ability to enhance students' understanding of environmental issues and sustainability.

Future research should explore the possibilities of interdisciplinary collaboration among teachers. By coordinating efforts across various subjects within the same degree program, institutions can address multiple SDGs simultaneously, providing students with a more comprehensive view of sustainability challenges and solutions.

Finally, it would be valuable to conduct longitudinal studies to assess the long-term impact of integrating SDGs into higher education.

REFERENCES

Abad-Segura, E., & González-Zamar, M. D. (2019). Análisis de las competencias en la educación superior a través de" flipped classroom". *Revista Iberoamericana de Educación, 80* (2), 19-45. https://doi.org/10.35362/rie8023407

Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research. *Higher Education Research & Development*, 34(1), 1-14. https://doi.org/10.1080/07294360.2014.934336

Akçayır, G., & Akçayır, M. (2018). The flipped classroom: A review of its advantages and challenges. *Computers & Education*, 126, 334-345. https://doi.org/10.1016/j.compedu.2018.07.021

Angulo, J. A. A. (2012). Valoración de estudiantes universitarios sobre las didácticas significativas para su aprendizaje. *Revista Iberoamericana de Psicología*, *5*(2), 31-40.

Annan-Diab, F., & Molinari, C. (2017). Interdisciplinarity: Practical approach to advancing education for sustainability and for the Sustainable Development Goals. *International Journal Management Education*, 15, 73-83. https://doi.org/10.1016/j.ijme.2017.03.006

Awidi, I. T., & Paynter, M. (2019). The impact of a flipped classroom approach on student learning experience. *Computers & Education*, 128, 269-283. https://doi.org/10.1016/j.compedu.2018.09.013

Banerjee, S.B. (2001). Managerial perceptions of corporate environmentalism: Interpretations from industry and strategic implications for organizations. *Journal of Management Studies* 38, 489-513.

Bansal, P., & Roth, K. (2000). Why companies go green: a model of ecological responsiveness. *Academy of Management Journal,* 43, 717-736. https://doi.org/10.5465/1556363

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Eugene: ISTE: International Society for Technology in Education.

Bieler, A., & McKenzie, M. (2017). Strategic planning for sustainability in Canadian higher education, *Sustainability,* 4 (2), 161. https://doi.org/10.3390/su9020161. https://doi.org/10.3390/su9020161

Blair, E., Maharaj, C., & Primus, S. (2016). Performance and perception in the flipped classroom. *Education and Information Technologies*, 21(6), 1465-1482. https://doi.org/10.1007/s10639-015-9393-5

Brandli, L.L., Leite, M.A., Roorda, N., Tolotti, K., & Canal, L. (2014). Evaluation of sustainability using the AISHE instrument: case study in a Brazilian University. *Brazilian Journal of Science and Technology*, 1, (4). https://doi.org/10.1186/2196-288X-1-4

Bristol, T. J. (2014). Flipping the Classroom. *Teaching and Learning in Nursing,* 9(1), 43-46. https://doi.org/10.1016/j.teln.2013.11.002

Build-FAbregá, M., Martínez Casanovas, M., Ruiz-Munzón, N., & Leal-Filho, W. (2019). Flipped Classroom as an Active Learning Methology in Sustainable Development Curricula. *Sustainability*, 11: 4577. https://doi.org/10.3390/su11174577

Centeno, M. E. C., Ocampo, J. E., González, M. J. P., & González, M. R. (2020). Implementación de la Agenda 2030 a través de un proyecto de investigación-acción aplicando la metodología flipped classroom. *Comillas Journal of International Relations*, (19), 51-71. https://doi.org/10.14422/cir.i19.y2020.004

Cervantes, A. V., & Valdez, A. D. F. (2020). Experimentation in the business school: a research model. *Journal of Management and Business Education*, *3*(3), 193-213. https://doi.org/10.35564/jmbe.2020.0013

Chaleta, E., Saraiva, M., Leal, F., Fialho, I., & Borralho, A. (2021). Higher Education and Sustainable Development Goals (SDGs)-Potential Contribution of the Undergraduate Courses of the School of Social Sciences of the University of Évora. *Sustainability*, 13, 1828. https://doi.org/10.3390/su13041828

Chankseliani, M., & McCowan, T. (2021). Higher education and the Sustainable Development Goals. *Higher Education*, 81, 1-8. https://doi.org/10.1007/s10734-020-00652-w

Chura-Quispe, G., García Castro, R. A., Llapa Medina, M. P., & Salamanca Chura, E. C. (2022). Efecto del Flipped Classroom virtual en la escritura académica: autopercepción de universitarios. *Pixel-Bit: Revista de Medios y Educación, 65, 121-148.* https://doi.org/10.12795/pixelbit.92509

Corvers, R., Wiek, A., de Kraker Lang, D.J., & Martens, P. (2016). Problem-based and project-based learning for sustainable development. *Sustainability Science*, 349-358. https://doi.org/10.1007/978-94-017-7242-6

Díaz Garrido, E., Martín-Peña, M. L., & Sánchez-López, J. M. (2017). The impact of Flipped Classroom on the motivation and learning of students in Operations Management. Working Papers on Operations Management, 8(SP), 15-18. https://doi.org/10.4995/wpom.v8i0.7091

Díez-Martín, F. (2018). Dónde estamos: Una introducción a la educación en los negocios. *Journal of Management and Business Education, 1*(1), 1-10. https://doi.org/10.35564/jmbe.2018.0001

El Miedany (2019). *Flipped Learning*. In: Rheumatology Teaching. Springer. https://doi.org/10.1007/978-3-319-98213-7_15

Estes, M. D., Ingram, R., & Liu, J. C. (2014). A review of flipped classroom research, practice, and technologies. *International Higher Education Teaching & Learning Association,* 4.

Estriegana, R., Medina-Merodio, J. A., & Barchino, R. (2018). Analysis of competence acquisition in a flipped classroom approach. *Computer Applications in Engineering Education*, *27*(1), 49-64. https://doi.org/10.1002/cae.22056

Fredriksson, P., & Persson, M. (2011). Integrating sustainable development into operations management courses. *International Journal of Sustainability in Higher Education*, 12(3):236-249. https://doi.org/10.1108/14676371111148027

Gilboy, M. B., Heinerichs, S., & Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. *Journal of nutrition education and behavior*, 47(1), 109-114. https://doi.org/10.1016/j.jneb.2014.08.008

Gross, B., Marinari, M., Hoffman, M., DeSimone, K., & Burke, P. (2015). Flipped@ SBU: Student satisfaction and the college classroom. *Educational Research Quarterly*, 39(2), 36.

Herrera, A. V. H., Vásquez, J. E. A., & Llaro, K. L. D. (2022). Estrategia del Flipped Learning en la enseñanza de la educación superior. *Horizontes Revista de Investigación en Ciencias de la Educación*, *6*(24), 1233-1248. https://doi.org/10.33996/revistahorizontes.v6i24.410

Hinojo-Lucena, F. J., Lopez Belmonte, J., Fuentes Cabrera, A., Trujillo Torres, J. M., & Pozo Sanchez, S. (2020). Academic effects of the use of flipped learning in physical education. *International* journal *of environmental research and public health*, *17*(1), 276. https://doi.org/10.3390/ijerph17010276

Hopkinson, P., & James, P. (2010) Practical pedagogy for embedding ESD in science, technology, engineering and mathematics curricula. *International Journal of Sustainability in Higher Education*, 11, 365-379. https://doi.org/10.1108/14676371011077586

Huppes, G., & Ishikawa, M. (2007). Sustainability evaluation: diverging routes recombined? Tasks for a new Working Group on Modelling and Evaluation for Sustainability. *Journal of Cleaner Production*, 15 (11-12), 1183-1184. https://doi.org/10.1016/j.jclepro.2007.01.001

Khanova, J., Roth, M. T., Rodgers, J. E., & McLaughlin, J. E. (2015). Student experiences across multiple flipped courses in a single curriculum. *Medical education*, *49*(10), 1038-1048. https://doi.org/10.1111/medu.12807

Kleindorfer, P.R., Singhal, K., & Van Wassenhove, L.N. (2005). Sustainable operations management. *Production and Operations Management*, 14(4), 482-492. https://doi.org/10.1111/j.1937-5956.2005.tb00235.x

Leal Filho, W., Wu, Y.C.J., Brandli, L.L., Avila, L.V., Azeiteiro, U.M., Caeiro, S., & Madruga, L. (2017). Identifying and overcoming obstacles to the implementation of sustainabledevelopment at universities. *Journal of Integrative Environmental Sciences*, 14 (1): 43-108. https://doi.org/10.1080/1943815X.2017.1362007

Lo, C. K., & Hew, K. F. (2017). A critical review of flipped classroom challenges in K-12 education: Possible solutions and recommendations for future research. *Research And Practice In Technology Enhanced Learning*, 12(4), 1-22. https://doi.org/10.1186/s41039-016-0044-2

Lozano, R., Barreiro-Gen, M., Lozano, F. J., & Sammalisto, K. (2019). Teaching sustainability in European higher education institutions: Assessing the connections between competences and pedagogical approaches. *Sustainability*, 11(6), 1602. https://doi.org/10.3390/su11061602

MacLeod, J., Yang, H. H., Zhu, S., & Shi, Y. (2018). Technological factors and student-to-student connected classroom climate in cloud classrooms. *Journal of Educational Computing Research*, *56*(6), 826-847. https://doi.org/10.1177/0735633117733999

Martín-Peña, M.L., Díaz-Garrido, E., Castillo, B., & Barrio del, L. (2011). Comparative study of methodological changes and student perception in the subject of Production and Operations Management for the acquisition of competences in the process of adaptation to the EHEA. *Revista de Formación e Innovación Educativa Universitaria*, 4(2), 126-144.

Martínez Casanovas, M., Ruíz-Munzón, N., & Buil-Fabregá, M. (2021). Higher education: the best practices for fostering competences for sustainable development through the use of active learning methodologies. *International Journal of Sustainability in Higher Education*, 23 (3): 703-727. https://doi.org/10.1108/IJSHE-03-2021-0082

Mingorance Arnáiz, C., & Calvo Bernardino, A. (2013). Student outcomes in an assessment process with different methodologies. *Revista de Investigación Educativa*, 31 (1), 275-293. https://doi.org/10.6018/rie.31.1.153291

Montero Curiel, M. L. (2010). El proceso de Bolonia y las nuevas competencias. *Tejuelo, 9*, 19-37.

Prajogo, D., Tang, A. K., & Lai, K. H. (2012). Do firms get what they want from ISO 14001 adoption: an Australian perspective. *Journal of Cleaner Production*, 33, 117-126. https://doi.org/10.1016/j.jclepro.2012.04.019

Prieto, A., Barbarroja, J., Alvarez, S., & Corell, A. (2021). Eficacia del modelo de aula invertida (flipped classroom) en la enseñanza universitaria: una síntesis de las mejores evidencias. *Revista de Educación*, *391*, 143-170. https://doi.org/10.4438/1988-592X-RE-2021-391-476

Queiruga, D., Benito, J. G., Valencia, L. A. R., & Nieto, G. L. (2015). Education for Sustainable Development in Operations Management subjects. The case of the Food Bank of the Rioja). WPOM, 6(1), 22-37. https://doi.org/10.4995/wpom.v6i1.3155

Rezaee, Z., & Elam, R. (2000). Emerging ISO 14000 environmental standards: a step-by-step implementation guide. *Managerial Auditing Journal,* 15 (1/2), 60-67. https://doi.org/10.1108/02686900010304650.

Rotellar, C., & Cain, J. (2016). Research, perspectives, and recommendations on implementing the flipped classroom. *American Journal of Pharmaceutical Education*, 80(2), 1-9. https://doi.org/10.5688/ajpe80234

Sohrabi, B., & Iraj, H. (2016). Implementing flipped classroom using digital media: A comparison of two demographically different groups perceptions. *Computers in Human* Behavior, 60, 514-524. https://doi.org/10.1016/j.chb.2016.02.056

Sola Martínez, T., Aznar Díaz, I., Romero Rodríguez, J. M., & Rodríguez García, A. M. (2019). Eficacia del método flipped classroom en la universidad: Meta-análisis de la producción científica de impacto. *REICE. Revista Iberoamericana sobre Calidad, Eficacia y Cambio en Educación, 17*(1), 25-38. https://doi.org/10.15366/reice2019.17.1.002

Sosa-Díaz, M. J., Guerra-Antequera, J., & Cerezo-Pizarro, M. (2021). Flipped classroom in the context of higher education: Learning, satisfaction and interaction. *Education Sciences*, *11*(8), 416. https://doi.org/ 10.3390/educsci11080416

Tilbury, D. (2011). *Education for Sustainable Development: An Expert Review of Processes and Learning*, UNESCO, Paris.

Tourón, J., & Santiago, R. (2015). Flilpped Learning model and the development of talent at school. *Revista de Educación*, (368), 196-231. https://doi.org/10.4438/1988-592X-RE-2015-368-288

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